泰國農產品碳足跡與碳標籤經驗分享

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摘要

泰國深切瞭解碳足跡(CF)與碳足跡標籤制度(CFL)的發展與執行對於減緩氣候變化的重要性，並期盼推動碳交易制度。相關碳足跡制度的建立起始於2008年，由歐盟與泰國發展共同合作計劃，同時在泰國溫室氣體管理機構、與國家科學技術發展機構(NSTDA)的共同主辦之下，也開始推動國家級先導計畫。此計畫吸引了利害關係人的高度興趣，因為體認到全球暖化問題的浮現，同時也因其準備對外提出有關於降低溫室氣體排放、與碳足跡標示的相關報告。除此之外，國家級先導計畫的參與者也包括了23家公司（43種產品），其中不僅有農產品及食品，也含括了包裝材料、紡織、汽車、電力、電子設備與建築材料等等。泰國碳足跡評估是以生命週期評估(LCA)為原則，是從生命週期的角度切入，同時也考量重要相關標準的要求，例如:英國的PAS 2050與日本的TS Q0010。在個案研究的實務基礎上，泰國於2009年時由國家技術委員會發展制訂了產品碳足跡的國家準則，該技術委員會主要是由各地區的生命週期評估(LCA)專家所組成。在這個階段，至少有120家公司（506種產品）已經獲頒碳足跡標籤認證；而其中有58家公司（293種產品）是屬於食品類。舉幾個榮獲碳足跡標籤認證的食物為例，像是香米、雞肉（新鮮肉

類、照燒肉）、鳳梨汁、樹薯粉、大豆油與棕櫚油。由於產品的屬性不同，依其類別再發展並制定產品類別規則（PCR）且成為國家準則的附屬新增規定。在泰國，產品類別規則的施行，可以分為兩種等級：（i）是由此類別產業第一家進行產品碳足跡盤查的公司起草規定且申請驗證碳足跡標籤，該申請案必須經由國家技術委員會針對產品碳足跡進行認證（此為公司等級）（ii）經泰國溫室氣體管理機構，與利害關係人進行諮詢會議，並經國家技術委員會，針對產品碳足跡進行認證（此為國家等級）。迄今，已經頒訂實施共74種公司等級之產品類別規則，其中40種是與食品相關；而也有3種國家等級之產品類別規則開始頒訂實施，其中紡織品又可分為紗線與織布、布料與非布料；食品為碾製米以及雞肉。關於全球性的產品類別規則之標準，則必須考量得更深入細微，原因是某些國家，會自行制訂發展出適用於本國的產品類別規則，例如以英國來說，追加了園藝相關、海產與其他水產類產品；而日本則是以蔬菜與水果的產品類別規則為主；泰國則著重在蔬菜、水果、家畜類、漁業與水栽類產品的類別規則。由於不同國家有不同的類別規則，因此造成彼此比較的障礙。有關於碳足跡計算工具，則屬於其他可發展的領域：包括有以網頁為基礎的碳足跡計算器(針對日常生活之活動，其所產生的碳足跡：像是旅遊、食品與辦公室)，“FOODprint”計算工具更是特別針對農產品及食物，適用於試算表之計算工具；而另外“Thai CF Pro” 計算工具目前則正在發展中，適用在試算表中所有分類的產品。因此，可以預見的是，會有一些碳足跡共通適用的準則，符合區域性與國際性之層級；但是還有一些標準化的問題，仍然需要更多的討論才能夠更臻完善。

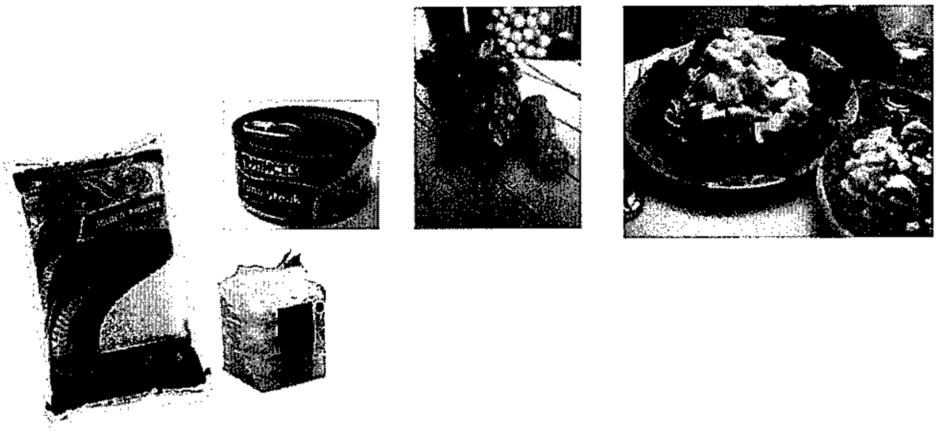
1. 導論

1.1. 碳足跡簡介

產品的生命週期過程中會產生溫室氣體(GHGs)，「碳足跡」即是評估溫室氣體的工具，目的在於確認熱點及降低排放量。相關產品被鼓勵以碳標籤的方式，提供碳足跡相關資訊給消費者，讓其在購買時能將產品對氣候友善程度列入考慮。我們期待碳足跡及標籤的作法，能夠刺激市場對低碳產品的需求，同時在生產與消費層面達到溫室氣體排放減量。許多國家已體認到全球暖化及氣候變遷的影響，包括泰國在內採納了碳足跡及標籤制度，而農產品是被認定為主要溫室氣體排放者的產業之一。

1.2. 泰國的碳足跡及標籤

泰國非常認同碳足跡及碳標籤的推動與執行對氣候變遷的緩和是有影響，也期待採納此交易制度。食品為此議題的焦點所在，主要原因在於其製造過程排放了大量溫室氣體，同時亦因為必須讓消費者認知到，其需改變消費行為以減少排放量。自2008年起，兩項針對雞肉產品(雞肉點心及烤雞)、鮪魚產品(鮪魚罐頭)及米食(香米/米粉)的碳足跡計畫已在泰國農業大學(Kasetsart University)及能源與環境聯合研究院(JGSEE)的合作下進行(Mungkung et al., 2012a; Mungkung et al., 2010b)。兩項計畫皆試圖讓民眾熟悉PAS 2050:2008 產品碳足跡驗證方案，並解決認知的落差。

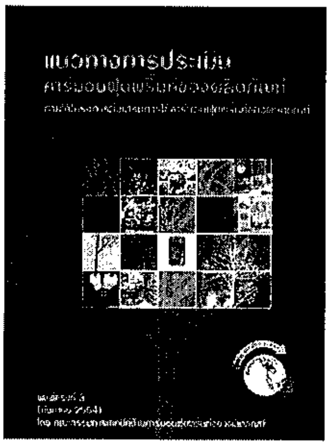


圖一 泰國首先採用碳足跡的農業食物產品

在2009年時，泰國溫室氣體管理組織(公共組織)(TGO)及全國金屬與材料技術中心(METEC)開始推動一項全國性產品碳足跡的先導計畫。總計有23家公司以展示的方式參與，其中包含：食物、包裝、紡織、電子電機設備、汽車及建材(總共43項產品)(圖二)。有趣的是，超過半數參與的公司(如雞肉、鮪魚、鳳梨、米製品、寵物食品及飼料)參與計畫不只是因為意識到全球問題，他們更希望企業在執行溫室氣體排放減量、揭露碳足跡資訊的推動成效被廣為宣傳。

圖二 在全國先導計畫中參與展示的公司

此先導計畫目的在於執行產品碳足跡及標籤，推動國家產品碳足跡及標籤計畫準則的發展(圖三)，此準則正式於2009年12月公告。其主要參考資料來源有：ISO 14040/44、PAS 2050:2008、TS Q 00010(日本技術準則)及氣候變遷專家委員會的國家溫室氣體排放盤查登錄準則。碳足跡評估的原則係建立在生命週期基礎之上，此一方法考慮了先前國家先導計畫中所面臨的實務問題，並適用於所有產品。

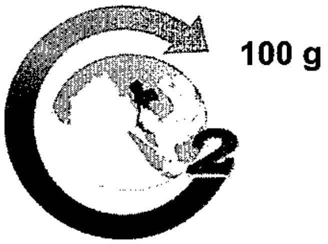


圖三 產品碳足跡及標籤計畫國家準則

附註：產品碳足跡國家準則的英文版可在下列網站取得
http://www.tgo.or.th/english/index.php?option=com_content&view=article&id=194:the-national-guideline-carbon-footprinting-of-product&catid=51:publication&Itemid=68

碳足跡的標籤係根據產品碳足跡國家準則所採用的方法，經第三方認證並以碳分數，XXX 公克或公斤，或 CO_2e(三個明顯的數字)(圖四)。在這個階段，並沒有任何承諾進行溫室氣體排放減量，但在政策層面已有所考慮。到目前為止 2012年10月，已有超過632項產品進行標籤，其中超過半數為食物產品。(請見下列網站 http://thaicarbonlabel.tgo.or.th/carbonfootprint/index.php?page=2)。碳足跡標籤有效期限為兩年，要延長效期，公司必須提交新版的

碳足跡報告並申請認證。



圖四 泰國碳足跡標籤的圖示

2. 農產品類產品類別規則的推動

因產品的屬性各異，有需要發展一套「產品類別規則」(PCRs)作為執行碳足跡的額外規定。在推動產品類別規則上，目前有兩種做法：產業部門及個別產品。令人憂心的是如果推動個別產品的產品類別規則，將無法配合企業運作與決策，但在關鍵產品上(如米製品、橡膠、蔬菜油)，因其碳足跡的特殊性，是否個別制定仍有爭議。

泰國產品類別規則實務的推動有兩個方式：(i)由第一個公司計算碳足跡，並向國家技術委員會為產品碳足跡申請標籤認證(產品類別規則，公司層級)；(ii)由泰國溫室氣體管理組織(TGO)以利害關係人諮詢會議的形式申請，並向國家技術委員會為產品碳足跡申請標籤認證(產品類別規則，國家層級)。一開始，米製品與雞肉產品被選擇以個別產品的方式，來發展國家產品類別規則。米製品為泰國的主要產品，具有特殊利益，同時，排放因素的資料來源對結果有顯著影響。雞肉製品則是另一項產品，因為是對歐盟國家的主要出口品，這些國家對碳足跡及標籤有所規定。更重要的是，兩種產品的製造商都積極採納碳足跡。隨後，農業製品產品類別規則的範圍也納入討論，其發現兩種產品有其產業特性，不應以次產業的方式分

門別類，而是該以不同產業別的方式，如蔬菜水果、畜牧類及魚類產製品等(漁業及水產養殖)。

到目前為止，公司層級有99項產品類別規則(其中40項與食物製品相關)，另有3項國家層級的產品類別規則(紡織，其中在細分為紗線及面料、服飾、非服飾；食物，細分為米製品及雞肉)。 農業製品類能進入國家產品類別規則最後核准階段者，為那些以次產業別方式發展者，亦即：蔬菜水果類產品類別規則、畜牧產品類別規則、及漁業與水產養殖產品類別規則，值得注意的是，PAS將此類產品類別規則歸類為海鮮及其他魚類製品。

2.1 農業製品產品類別規則所涵蓋範圍

農業製品的產品類別規則，是以次產業別的方式推動，亦即：蔬菜水果產品類別規則、畜牧類產品類別規則、及漁業與水產養殖產品類別規則。在每項次產業別內，非加工及加工類製品均應被歸類為加工製品，其需要如生鮮水果蔬菜的原料製作，因此最好是能合併處理產品類別規則此一議題。值得注意的是，具有多重成分的食物加工製品(如蔬菜、肉類及椰奶等)一般被認為應被歸於另外的產品類別規則中，但必要時亦可被視為相關類的產品類別規則，如蔬菜水果、牲畜、漁業及水產養殖等。肉、奶及蛋類被歸類為牲畜類製品，而來自漁業及水產養殖活動的產品(從淡水、半鹹水及海洋)則被歸為漁業及水產養殖產品。

2.2 系統邊界

一般而言，系統所涵蓋範圍應包含產品全部的生命週期階段，從銷售端(如鮮蔬冷藏)、消費前(如家庭冷藏)、消費(如烹調)、及消

費後(如食物及廚餘處理)，若為食物成分則為例外，因為其僅為其他餐飲或飲食的組成成分之一(Mungkung et al., 2010a; Mungkung et al., 2010b; Mungkung et al., 2010c)。此外，銷售端、消費前、消費及消費後的假設是建立在同樣食物產品需有同樣的比較基礎上；銷售端的假設為實際狀況的食物周轉率，烹煮前或消費前儲藏的定義是採標準狀態。目前，使用歷程(use profile)的認定是根據製造商在標籤上的說明，因為無論是ISO 14025標準及泰國綠色標籤計畫(Ecolabel Type 1)均無此項資料。不過，若僅為食物成分的狀況下，得以排除使用歷程。最終廢棄物處理亦適用標準情境(假定無食物殘留，所有廢棄物亦掩埋)。在此要說明的是，辦公室、研發、品管、人力、員工及消費者移動等資訊並未包含在內。

更為細部的資料應涵蓋下列活動：土地準備(在作物生產前)、種子準備、施藥(如施肥、激素、鋤草、牲畜施藥等)、播種、基板材料、土壤覆蓋材料、包裝及維護機具之消耗品等。須排除的活動為：基礎設施、器具及機械。直接土地利用方式的改變亦涵蓋在內，但一開始僅為作物生產(並非全部土地利用變更)，並僅追蹤執行碳足跡前的20年。儘管土地利用變更對溫室氣體排放的影響甚鉅，產業界認為開發中國家並沒有足夠的資料用以支持這樣的觀點。碳儲存亦涵蓋在內，但此僅為選項，並應與碳足跡數值分別陳報。碳補償必須被排除在外(VGREEN-KU, 2012)。

2.3. 產品描述

在描述一項產品時，須包含產品名稱、品牌名稱、及品質排名，此排名係根據泰國農業標準(TAS)所界定之國家標準。所有在最終產品階段納入的配件均須列入。產業界提出一項有關於農產品數量的

實務議題，因為產品分類在庫存單位(SKU)層面有上千種分類，附帶成本(如輔導服務、認證)將會是一大負擔，特別是中小企業(SMEs)(Mungkung et al., 2010c)。與此相關聯的，為推動產業採納碳足跡，應容許產品集中分類以降低認證成本(整個產品分類的值適用到個別碳足跡含量)；舉例來說，不同口味的泡麵或大小不同的蔬菜油可以被歸類在一起。

2.4 功能單位

在功能單位上究竟應以總重量、淨重、食用蛋白、營養成分或熱量內含為主，仍有很大的爭議，而運用這些單位會產生不同的結果。在此一階段，一般同意在概念上，碳足跡的分析單位應為產品的功能單位，但對於何種單位最能發揮產品比較功能仍未有定見。因此為了產品比較，我們採用包裝尺寸所用的單位，並附加額外技術資訊(如有機農業、淨/固形重、卡路里等)(VGREEN-KU, 2012)。

2.5. 資料規定與蒐集

原則上需要兩種形式的資料：活動資料(如活動過程的輸入及輸出)及排放因素(EF)的背景資料。所有直接及可以取得資料，如契作或分公司/合夥公司的活動須為初級資料，而間接或無法取得資料的活動可為次級資料。次級資料來源必須是國家級資料庫、以泰國為背景的同儕審查期刊、國家技術報告、內部資料庫及國際技術報告(逐步)。在無法取得初級及次級資料的情況下，也容許以相同原物料中最高的排放因素做為替代資料(VGREEN-KU, 2012)。

農產品所有次產業部門面臨的問題，在於如何蒐集原物料生產的資料，這主要是因為原物料通常是來自數個不同地點的農產地(透過

拍賣或中央市場)，因此需要與利害關係人討論抽樣原則，而表一詳列了逐步討論的結果。原則上，資料蒐集應包含年度生產使用其原物料的農田數目，其使用比例至少為50%。若是數目太大，主要是因為小農數目太多，則可以取全部農田數的平方根方式處理。若受到氣候變化影響，可以採計以省級特定區域的輸入及輸出資料，納入農業部建議的收成數；若執行碳足跡時收成受到非季節因素影響，再加以調整(以前三年收成平均數) – 這僅對那些有統計資料的水果蔬菜適用，牲畜及漁產養殖則不適用。

一般而言，資料蒐集期間是依據水果蔬菜的年生產期，或者動物製品如奶或蛋的生命週期(但如果在生命週期結束前已預先處置，資料蒐集期間即到處置的時點為止)。但如果收成量的差異超過 10%，則以三年產量來衡量其變異程度較為合理(VGREEN-KU, 2012)。

表一 逐步法則(VGREEN-KU, 2012)

資料類型	農產品		
	水果及蔬菜	畜產品	漁業及水產養殖
原始資料（若其為執行公司的直接活動）	(1)農場數量至少佔年產量使用原料的50% (2)如果農場數量太大且也不符合條件(1)，則可根據所有農場總數的平方根定律取樣。(根據分析農場之間的變化)	(1)農場數量至少佔年產量使用原料的50% (2)如果農場數量太大且也不符合條件(1)，則可根據所有農場總數的平方根定律取樣。(根據分析農場之間的變化)	(1)農場數量至少佔年產量使用原料的50% ((2)如果農場數量太大且也不符合條件(1)，則可根據所有農場總數的平方根定律取樣。(根據分析農場之間的變化)
輔助資料（若其為執行公司的間接活動）	(1)找出至少佔年產量使用原料50%的來源; (2)根據某一個省級特定區域典型的做法，包括農業部建議的產量，套用投入及產出，若當下的實施碳足跡的農地受到不正常天氣的影響，則可用調整過後的產量(前三年的平均產量)	文獻均來自國家數據庫資料(泰文)	文獻均來自國家數據庫資料(泰文)

2.6 分配方法

在主要產品及共同產品間分配碳足跡時，係採用ISO14040/44標準的逐步法則：分別是系統發展、物理關係及經濟關係。但實務上，系統不可能一直發展，所以根據物理關係來分配是最常見的作法，如根據全米跟碎米的質量來分配、根據整顆鳳梨及切片的質量來分配、或根據棕欖油之能源含量來分配(VGREEN-KU, 2012)。

2.7 實質性及截斷原則

實質性的定義為一項物件對全部碳足跡的貢獻度少於1%，截斷點為不得高於5%， 這係遵照ISO 14067草案版及其他國家標準的規定。加總回乘截斷後的碳足跡值，可以得到碳足跡的含量。

2.8 碳足跡 標籤標示

碳足跡是標示在B2C產品的包裝上(若為B2B產品，碳足跡應在網站、傳單、目錄上顯示，而非包裝)。在這階段，一些民間公司提案製作一個碳足跡標籤的圖像，而不是一整張圖，被授權者並須承諾在延長授權期間時會減量，這意味認證者及主管機關將確保碳足跡的計算係根據國家準則，同時也督促申請人能對碳足跡減量。這正在政策層面上考慮。另外，眾人也在討論泰國綠標籤(ecolabel type 1)制度是否要將氣候列入考量。.

3. 碳足跡工具

產業界普遍認為，由他們自己進行碳足跡調查並不容易，因為其不具備技術背景及財務能力。職是之故，泰國政府及大學開發了一些工具以協助計算碳足跡，也就是Thai CF Pro，一般產品，根據

國家準則、FOODprint，食物製品，根據PAS 2050(Gheewala and Mungkung, 2012)，及CF Pack，食物及飲品，根據國家準則。同時，泰國亦憂慮消費者能夠自碳足跡標籤解讀多少資訊，所以也開發了網路版的碳足跡計算器，讓其計算每日活動(食物、交通、家庭)所產生的碳足跡。

4. 總結

總而言之，泰國意識到碳足跡及其標籤的執行與推動對減緩氣候變遷的效益，同時亦期待碳交易制度的採納，這些均使得泰國成為東南亞國協及開發中國家中，第一個推動並執行碳足跡及標籤的國家。就農產品而言，碳足跡可以協助認定熱點以尋求改善，比較不同的耕作方式或選擇新的產品技術，及開發低碳足跡產品。綜其原因，泰國食品公司採納碳足跡及標籤的主要驅動力來自：溫室氣體排放措施及管理所能降低的成本、為未來市場趨勢預做準備(政策及操作標籤的溫室氣體措施及管理)、及溫室氣體報告(領導廠商的全球永續性報告指標、或環境永續/企業社會責任報告)。碳足跡同時也被推廣作為一場行銷工具，藉以標示氣候友善產品，選擇具氣候責任的供應商，並創造具氣候意識的市場管道。更重要是，在執行碳足跡後，公司開始意識到潛在影響，碳足跡只是其中的一部分。

5. 展望

農產品碳足跡及標籤要能進一步發展，須先解決下列問題：

- 開發一套國家產品類別規則需要花很長的時間，亦須與不同背景及經驗的利害關係人合作，過程中要怎麼把這些利害關係人納入?
- 不同國家對同樣產品有其國家產品類別規則，要怎麼在國際層級

上進行標準化?

- 開發中國家在碳足跡及交易制度上，缺乏食物資料庫及生命週期評估專家，要怎麼在不損及開發中國家貿易機會的狀況下，以碳足跡為工具推動綠色經濟?

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Carbon footprinting and labelling of agri-food products: Experiences from Thailand

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Abstract

Thailand is very well aware of the development and implementation of Carbon Footprinting (CF) and Carbon Footprint Labelling (CFL) for climate change mitigation as well as to anticipate trade measures. It was firstly introduced in 2008 via an EU-Thailand collaborative project along with the national pilot projects under the auspices of the Thailand Greenhouse Gas Management Organization, Public Organization (TGO) and the National Science and Technology Development Agency (NSTDA). These gained a high interest from the stakeholders because of because of their awareness on global warming issues and also because they would like to prepare themselves for reporting, reducing GHG emissions, and labelling the carbon footprint information. Along with that, the national pilot project was conducted with the participation from 23 companies (43 products) covering not only agri-food and packaging but also textile, automobile, electrical and electronic equipment and building materials. The principles of CF assessment are rooted in Life Cycle Assessment (LCA) using the life cycle approach,

while considering the requirements of key references (PAS 2050, UK; TS Q0010, Japan). Based on the practical experiences gained from the case studies, the national guidelines on product CF were developed in 2009 by the national technical committee who mainly are local LCA experts. At this stage, there are at least 120 companies (506 products) that have been awarded CFL; out of these, there are 58 companies (293 products) from food. Examples of food product carrying CFL are: jasmine rice, chicken (fresh meat, teriyaki), pineapple juice, cassava and tapioca, soybean oil, and palm oil. Due to different characteristics of products, this has led to the development of "Product Category Rules" (PCRs) as additional requirements from the national guideline. The practices of PCR development in Thailand are at two levels: (i) by the first company who calculated CF and applied for verification for CFL approved by the national technical committee on product carbon footprint (PCR, company level), (ii) by TGO with the stakeholder consultation meeting and approved by the national technical committee on product carbon footprint (PCR, national level). Until now, there are 74 PCRs, at the company level (40 of these are concerning food products) and 3 PCRs at the national level (textiles divided into yarn and fabric, clothing, non-clothing; food which are milled rice and chicken meat). There is a great concern over the standardization of PCRs at global scale as some countries might have developed their own PCRs, for instance, the UK (i.e. Supplementary requirement of horticultural and seafood and other aquatic products), Japan (PCR of vegetables and fruits) and Thailand (PCR of fruit & vegetables, PCR of livestock products and PCR of fisheries and aquaculture products) in their own systems which could be a barrier in comparing between products from two countries. CF tools are also another area of development: Web-based CF calculator (CF of activities in daily life: travelling, food and

office), “FOODprint”, a calculation tool specific for agri-food products in spreadsheets, and “Thai CF Pro”, a calculation tool for all kinds of products in spreadsheets, are being developed. It is foreseen that there are some common principles on CF that can be in agreement at the regional/international levels while some issues will still need more discussion for standardization.

1. Introduction

1.1. Introduction to carbon footprint

“Carbon Footprint” has emerged as a tool to assess greenhouse gas (GHG) emissions throughout the product’s life cycle, aiming to identify the hot spots and stimulate emission reduction. The carbon footprint information is also encouraged to be provided to consumers via Carbon Label as an indicator of the climate-friendliness to take into account in their purchasing decisions. The carbon footprint and label strategy is expected to stimulate a market demand for lower carbon products to move towards the reduction of GHG emissions at both production and consumption. The concept of carbon footprint and carbon label is well accepted, leading to the development of ISO 14067 which is to be officially launched in 2013. Having recognized the significance of global warming and climate change impacts, several countries have adopted carbon footprinting and labelling schemes including Thailand. Agri-food is identified as one of the main industrial sectors contributing significantly to GHG emissions.

1.2. Carbon footprint and label in Thailand

Thailand is very well aware of the development and implementation of Carbon Footprinting and Carbon Labelling for climate change mitigation

as well as to anticipate trade measures. Food has been the focus on this particular issue, due mainly to its contribution in GHG emissions at the household level and as it is the main product for all consumers who should be convinced to change their consumption behavior towards lower emissions. Initiated in 2008, two carbon footprint projects on carbon footprinting of chicken (Chicken snack and Steamed diced oven chicken), tuna (Canned tuna in sunflower oil) and rice (Jasmine rice and Rice vermicelli/noodle) were conducted by Kasetsart University (KU) and the Joint Graduate School for Energy and Environment (JGSEE) (Mungkung et al., 2012a; (Mungkung et al., 2010b). Both projects were aimed to familiarize with the PAS 2050: 2008 methodology which was available at that point of time and identify the local knowledge gaps.

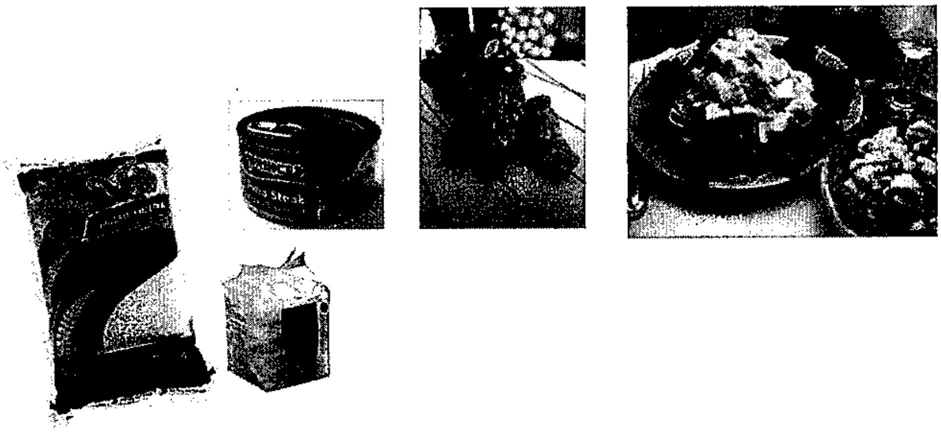

Figure 1: Pioneering agri-food products for carbon footprinting in Thailand

In 2009, a national pilot project to promote the implementation of product carbon footprint was initiated by the Thailand Greenhouse Gas Management Organisation (Public Organisation) (TGO) and National Metal and Materials Technology Centre (MTEC), Thailand. There were 23 companies involved as demonstration projects, which included: food, packaging, textile, electrical and electronic equipment, automobile, and

building materials (43 products in total) (Figure 2). Interestingly, more than half were food companies (such as chicken, tuna, pineapple, rice, pet food, and animal feed), they joined the project because of their awareness on global warming issues and also because they would like to prepare themselves for reporting, reducing GHG emissions, and labelling the carbon footprint information.

Figure 2: Companies involved as demonstration projects in the national pilot project

The project was targeted at the implementation of product carbon footprinting and labelling leading to develop the national guidelines on product carbon footprint as well as the national carbon footprint labelling scheme (Figure 3) which was launched officially in December, 2009. The key references were: ISO 14040/44, PAS 2050, TQ 00010 (Japanese Technical Guideline) and IPCC guidelines for national GHG emission inventories. The principles of carbon footprint assessment are rooted in the life cycle approach and the main methodological issues are applicable for all kinds of products with the consideration of practical

issues based on the experiences gained from the national pilot project.

Figure 3: National guidelines on product carbon footprint and labelling scheme (Note: the national guideline of product carbon footprint in English is available at http://www.tgo.or.th/english/index.php?option=com_content&view=article&id=194:the-national-guideline-carbon-footprinting-of-product&catid=51:publication&Itemid=68)

The carbon footprint labelling is based on the methodology described in the national guideline of product carbon footprint with third-party verification and expressed as carbon score, XXX g or kg CO_2e (three significant digits) (Figure 4). At this stage, there is no commitment of GHG emission reduction but it is being considered at the policy level. Up to date (October 2012), there are more than 632 products being labelled from 143 companies and more than half are food products [Available at http://thaicarbonlabel.tgo.or.th/carbonfootprint/index.php?page=2]. The carbon footprint label is valid for 2 years and the companies must submit the updated carbon footprint report as well as applying for verification again for license extension.

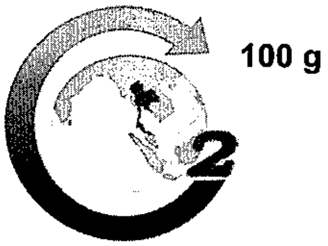

Figure 4: Symbol of Thai carbon footprint label

2. Development of PCRs in agri-food products

Different characteristics of products have been recognised thus leading to the need for development of "Product Category Rules" (PCRs) as additional requirements for carbon footprint implementation. It was considered that there were two approaches in developing PCR: sector-based or individual product-based. It was concerned that the development of PCR at individual level would be time-consuming and was not be able to respond to the business operations and decisions. However, still there was debated that some key products (such as rice, rubber, vegetable oil) should be developed individually due to theirs special issues in carbon footprinting.

The practices of PCR development in Thailand are at two levels: (i) by the first company who calculated the carbon footprint and applied for verification for the carbon footprint label approved by the national technical committee on product carbon footprint (PCR, company level), (ii) by TGO with the stakeholder consultation meeting and approved by the national technical committee on product carbon footprint (PCR, national level). At the beginning, rice and chicken were selected for developing the national PCRs to test the approach used in individual product-based PCRs. Rice was of special interest as it is a main product for Thailand and the data sources of emission factors from rice fields

affect the results significantly. Chicken was another product selected as it is mainly exported to EU countries which are active on carbon footprinting and labelling. Moreover, the manufacturers of these two products have been proactive in adopting carbon footprinting. Later on, the scope of PCRs of agri-food products was discussed and it was found that each sector has its own characteristics and should not be considered at the sub-sectorial rather than sectorial level such as Fruit & Vegetables, Livestock, and Aquatic products (Fisheries and Aquaculture).

Until now, there are 99 PCRs, at the company level (40 of these are concerning food products) and 3 PCRs at the national level (textiles which divided into yarn and fabric, clothing, non-clothing; food which are milled rice and chicken meat). The national PCRs that are in process of final approval are the PCR agri-food which was developed based on sub-sector, namely: PCR of fruit and vegetables, PCR of livestock, and PCR of fisheries and aquaculture (it is worth noted here that PAS calls this PCR seafood and other aquatic food products). Some key issues of PCR agri-food are highlighted here.

2.1 Scope of agri-food PCRs

The PCR of agri-food was developed based on sub-sector, namely: PCR of fruit and vegetables, PCR of livestock, and PCR of fisheries and aquaculture. Within each sub-sector, both non-processed and processed products should be considered as the processed products would require the raw materials such as fresh fruits and vegetables so it is best to deal with the PCR issues altogether. It should be noted here that it is generally agreed that processed food products with multiple ingredients (i.e. vegetable, meat, coconut milk, etc.) should be considered in a

separate PCR but can refer to the related parts in PCR of Fruit & Vegetables, Livestock, and Fisheries and aquaculture as required. Meat, milk, egg are considered livestock products, whereas products from fisheries and aquaculture (from fresh, brackish and sea water) activities are reflected in fisheries and aquaculture products.

2.2 System boundary

It is generally accepted that the system boundary should cover all life cycle stages including at the sale's point (e.g. chilled storage), pre-consumption (e.g. household storage), consumption (e.g. cooking), and post-consumption (e.g. food and packaging waste disposal) except in the case of food ingredients as they are only a composition of other food products in the forms of dish or meal (Mungkung et al., 2010a; Mungkung et al., 2010b; Mungkung et al., 2010c). It is also important that the assumptions of sale's point, pre-consumption, consumption and post-consumption are on the same basis for the same food products. The assumption at sale's point is based on the turn-over rate in the real situation. The storage prior to cooking or pre-consumption is defined based on a standard scenario. As of now, the use profile is defined according to the instruction given by producer on the labels as there is no such data available in ISO 14025 as well as the Thai Green Labelling scheme (Ecolabel Type 1). However, the use profile excluded in the case of food ingredients as they are only a composition of other food products in the forms of dish or meal. A standard scenario is also applied with the final waste disposal (assuming there is no food waste and packaging waste is totally landfilled). It is worth mentioning here that office, research and development, quality assurance and control, human energy, workers' travelling and consumer's travelling are not included.

In more details, these activities should be included: land preparation (prior the crop production), seed preparation (such as soaking in water, acclimatization in pond, etc.), chemicals (such as fertilizer, hormones, herbicides, veterinary drugs, etc.), feed, substrate materials, soil covering materials, packaging and consumables for maintenance of capital goods. The activities that should be excluded are: infrastructure, equipment, and machines. Direct land use change is included, but at the beginning only for crop production (not all land use changes) and only 20 years back to the date of implementing the carbon footprinting. Though it is understood that the effects of land use change on GHG emissions is enormous but still the industry feels that developing countries will have a major problem with the lack of supporting data. Carbon storage will also be included, but this is optional and should be reported separately from the carbon footprint value. Carbon offset must be excluded (VGREEN-KU, 2012).

2.3. Product description

The information of product name, brand name, and quality ranking according to the national standard defined in the Thailand Agriculture Standard (TAS) documents are required in describing the product. All auxiliaries included in the finished product being sold must also be considered. A practical issue raised by the industry is related to the number of agri-food products which can be classified into some thousands at the SKU (Stock-Keeping Unit) level. The industry echoed that the associated costs (for consultancy service, verification and license) could be a barrier especially for SMEs (Small and Medium Enterprises) (Mungkung et al., 2010c). In this connection, to promote the adoption of carbon footprint product grouping is allowed for the sake of cost reduction for the license (individual carbon footprint value is still

applied for each product across the whole product group); for instance, different tastes of instant noodles or different sizes of vegetable oil in bottles can be grouped.

2.4 Functional unit

There was a huge debate on functional unit, which could be based on total weight, net-drained weight, edible protein, nutritional level or energy contents. It is obvious that different functional unit could yield different results. At this stage, it is generally agreed at the conceptual level that the unit of carbon footprint analysis should reflect the functional unit of product. But still it is not settled which unit would be the best choice to facilitate the product comparison. Thus, the sold unit based on packaging size, with the additional technical information (such as organic farming, net/drained weight, kcal per pack, etc.) to facilitate the product comparison is being applied (VGREEN-KU, 2012).

2.5. Data requirement and collection

In principles, there are two kinds of required data: activity data (i.e. inputs and outputs of processing activities) and Emission Factors (EF) of background data. All direct activities and activities with data accessibility (e.g. contract farming or branch/sister companies) must be primary data, while all indirect activities or data with no accessibility can be secondary data.

The sources of secondary data must be from national database, peer-reviewed journal based on Thai context, national technical reports, internal database and international technical reports (step-wise). It is also allowed to use the substitute data from the highest EFs within the same group of raw materials/ingredients, in case of no available primary

and secondary data (VGREEN-KU, 2012).

The typical issues among all sub-sectors in agri-food are the data collection of raw material production. This is mainly due to the sourcing of raw materials from multiple farms in different locations (via auction or central markets), thus sampling rules were discussed with stakeholders and came up with the stepwise sampling rule detailed in Table 1. In principle, the data collection should include the number of farms covering at least 50% of the raw materials used for annual production. If it is not possible due to a numerous number of farms (mainly are small holders), then the sampling based on square root rule of the total number of farms can be used. In case of being affected by climate changes, it is allowed to apply the input and output based on a typical practise in a particular area at the provincial level) including yield suggested by the Department of Agriculture, with the adjusted yield (the average yield from previous 3 years) if at the time of implementing the carbon footprint the yield is affected by unusual seasonal factors – this is the case for fruits and vegetables only as there are statistical data, but not for livestock and fisheries/aquaculture.

The duration of data collection is generally acceptable to be based on annual production for fruits and vegetables, or over the life span of animal producing milk or egg (but if they are pre-disposed before reaching its life span then the data collection should be finished by then). But if the yield is fluctuating more than 10%, then it is reasonable to use the data over 3 years of production to capture the variation to achieve a good representative data (VGREEN-KU, 2012).

Table 1: Stepwise sampling rule (VGREEN-KU, 2012)

Data type	Agri-food products		
	Fruit & Vegetables	Livestock	Fisheries and aquaculture
Primary data (if it is the direct activity of implementing company)	(1) Number of farms covering at least 50% of the raw materials used for annual production; (2) If the number of farms is huge and (1) is not practicable, then sampling based on square root rule of the total number of farms can be used (with the justification after analysing the variation among farms);	(1) Number of farms covering at least 50% of the raw materials used for annual production; (2) If the number of farms is huge and (1) is not practicable, then sampling based on square root rule of the total number of farms can be used (with the justification after analysing the variation among farms);	(1) Number of farms covering at least 50% of the raw materials used for annual production; (2) If the number of farms is huge and (1) is not practicable, then sampling based on square root rule of the total number of farms can be used (with the justification after analysing the variation among farms);
Secondary data (if it is the indirect activity of implementing company)	(1) Identify the sources of raw materials covering at least 50% of the raw materials used for annual production; (2) Apply the input and output	(1) Obtain from the national databases, which were sourced from the literature (Thailand context)	(1) Obtain from the national databases, which were sourced from the literature (Thailand context)

	based on a typical practise in a particular area at the provincial level) including yield suggested by the Department of Agriculture, with the adjusted yield (the average yield from previous 3 years) if at the time of implementing the carbon footprint the yield is affected by unusual seasonal factors		

2.6 Allocation method

For the allocation of carbon footprint between main product and co-products, the stepwise rules based on ISO14040/44 are applied: system expansion, physical relationship, and economic relationship respectively. However, it was considered that system expansion is not always possible in practices. Thus, the allocation based on physical relationship is mostly applied, such as allocation between full-grain rice and broken rice based on mass, allocation between pineapple body and theirs shells/cores/small pieces based on mass, or allocation of palm oil based on energy contents (VGREEN-KU, 2012).

2.7 Materiality and Cut-off rules

The materiality is defined as the item contributing lesser than 1% of the total carbon footprint and the cut-off must not be higher than 5% of the total carbon footprint, which follows the requirement in ISO 14067 and other national standards. Scaling-up the carbon footprint value after cut off must be done to finalize the carbon footprint value.

2.8 Display of carbon footprint label

The carbon score is displayed on pack for B2C products (in case of B2B, CF should be displayed on website, leaflet, catalogue but not on pack). At this stage, private companies proposed an idea to have a logo of the carbon footprint label without displaying a figure, but having a commitment to reduce the value when extending the license. This implies that the verifier and the authority body will ensure that the carbon footprint calculation is done according to the national guideline and the carbon footprint value reduces from the previous time. This is being considered at the policy level. On another point of view, it is discussed that should the Thai green label (ecolabel type 1) consider incorporating the climate aspects.

3. CF Toolkits

The industry all agree that CF is not easy for producers to conduct the carbon footprint study by themselves due to limited technical background and financial capacity. In this connection, there are some carbon footprint toolkits developed in Thailand by governmental organization and universities to facilitate the carbon footprint calculation, which are Thai CF Pro (for general products, based on the national guideline), FOODprint (for food products, based on PAS 2050)

(Gheewala and Mungkung, 2012), and CF Pack (for food and drink packaging, based on the national guideline). Also, a great concern is given to the consumers' understanding about the information conveyed via carbon footprint label. Thus, a web-based CF calculator was developed to provide the CF calculation of daily activities (food, transport, home, office) to raise theirs awareness.

4. Summary

In summary, Thailand is very well aware of the development and implementation of carbon footprint and label for climate change mitigation as well as to anticipate trade measures, leading to be the fist country in ASEAN and developing world to develop and implement carbon footprint and label. For agri-food, it is seen that CF can help identifying hot spots for improvement, comparing different farming systems or selecting new and current products/technologies, and creating low-carbon footprint products. On top of that, the main driving force in adopting carbon footprint and label by Thai food companies are from: GHG measurement and management for cost reduction, preparation to anticipate the trend of market requirements (GHG measurement and management at policy and operation label as well as carbon footprint label), and GHG reporting (GRI report for leading companies, or environmental/sustainability/CSR reports). CF is also being promoted as a marketing tool to indicate climate-friendly products, select climate-responsible suppliers, and create climate-conscious market access. More importantly, after practicing CF the companies then started to realize that all potential impacts included in LCA should be considered rather than CF as it is only a single aspect.

5. Outlook

The further development of carbon footprint and label in agri-food product needs the answers for these following main issues:

- Development of national PCRs takes time and stakeholders with different background and experiences, how to take stakeholders into account?
- National PCRs based on individual contexts of same products in several countries, how to standardize at international level?
- CF & Trade as developing countries are lacking of food databases and LCA experts, how to promote CF as a tool to move towards green economy without compromising the trade opportunities of developing countries?

6. References

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